CONGRESSIONAL TESTIMONY

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SUNY Brockport College and Rochester City (SCOLLARCITY) Math and Science Partnership (NSF EHR-0226962)

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Core Partners:

- **SUNY Brockport (College)**
- **Rochester City School District (RCSD)**
- **Brighton Central School District (BCSD)**

Supporting Partners:

- **Shodor Education Foundation**
- **The Krell Institute**
- **Texas Instruments**
- **Xerox Corporation**
- **Research Foundation of SUNY**
- **Monroe County School Boards Association**
- **The Council of Chief State Schools Officers**

I. PARTICIPANTS

SUNY Brockport College:
Dr. Osman Yaşar- Principal Investigator and Chair of the Computational Science Dept.
Dr. Timothy J. Flanagan- Provost and Vice President of Academic Affairs
Sue Barocas- Project Coordinator
Amanda Duncan- Project Secretary
Gerry Moon- Technology Specialist
Dr. Leigh Little- Faculty and Workshop Coordinator at Computational Science Dept.
Dr. Robert Tuzun- Faculty and Scholarship Coordinator at Computational Science Dept.
Dr. K. Raj- Faculty and Recruitment Coordinator at Computer Science Department
Dr. Jose Maliekal- Faculty and Technology Coordinator at Earth Science Department
Dr. Mark Heitz- Faculty and Industry Coordinator at Chemistry Department
Dr. Mohammed Tahar- Faculty and Challenge Coordinator at Physics Department
Dr. Dawn Jones- Faculty and Web Coordinator at Mathematics Department
Dr. Peter Veronesi- Faculty and Internal Evaluator at Education Department
Dr. Betsy Balzano- NCATE Accreditation Coordinator at Education Department
Dr. Richard Mancuso- Faculty and Chairperson of Physics Department
Dr. Tom Kallen- Faculty Chairperson of Chemistry Department
Dr. Charles Sommer- Faculty Chairperson of Mathematics Department
Debra Dilker – Secretary at Computational Science Department
Dr. Michael Fox, Vice Provost, Co-Chair of the Strategic Plan
Dr. Susan Stites-Doe – Dean of Graduate School
Dr. Stuart Appelle, Dean, School of Letters and Sciences
Dr. Michael Maggiotto, Former Dean of School of Letters and Sciences
Julian Ortiz – Admissions Specialist, Graduate School
Bernie Valento – Director of Undergraduate Admissions
Adrienne Collier – Affirmative Action Office
Dr. Kenneth O' Brien – Faculty Senate President
Peter Dowe, Jenice Stewart – Registration and Records
Nick Mascari – Media Relations (News Releases)
Terry Baker, Mark Gardner - Brockport Auxiliary Service Corporation (catering events)
Brian Volkmar, Anne Parsons, Mary Jo Orzech – Information Technology Services

Teachers Candidates (Undergraduate Students):
Laura Merkl, Davis Joki, Scott Koch, Gerald Moon, Christina Olsowsky
Teacher Candidates (Graduate Students): Maria Roman

Research Foundation of SUNY
Sylvia Tortora, Sandy Mosher, Laura Merkl – College at Brockport
Dr. Guven Yalcintas, Vice President, Technology Transfer – Headquarters at Albany

SUNY Central Administration
Kate Van Arnam, Assistant Vice Provost, Program Review and Planning, SUNY, Albany

Rochester City School District (RCSD):
Dr. Manual Rivera - Superintendent
Michael Robinson and David Silver- Deputy Superintendents
Margaret Crowley-Director of Mathematics Instruction, Co-Director of CMST Institute
Tim Cliby-Managing Director of Instructional Technology
Dr. Paul Helberg – Technology Specialist and Consultant
Rebecca Boyle – Mentoring Coordinator
Jeff Mikols-Lead Teacher for Secondary Mathematics, CMST Project Coordinator at RCSD
Mike Christmen, Andy MacGowan, Nicole Crocker - Research Data Collection

School Principals Participating from RCSD:
High Schools:
- Marilynn Patterson-Grant (Wilson Magnet School)
- Kathleen Lamb (East High School)
- Kim Dyce (Franklin High School)
- Dan Drmacich (School Without Walls, SWW)
- Clinton Strickland (Edison Tech)
- Jerome Watts (Lofton Academy)

High School and Middle School:
- Dominic Bona (School of the Arts, SOTA)
- Joseph Munno (Marshall High School)

Middle Schools:
- Dr. Andrew Ray (James Madison School of Excellence, JMSE)
- Linda Dianetti (Monroe Middle School)
- Barbara Hasler (Frederick Douglass Middle School, FDMS)
- Deborah Rider (Charlotte Middle School)
- Donna Gattelaro-Andersen (Dr. Freddie Thomas Learning Center, FTLC)
- Connie Wehner (Nathaniel Rochester Community School, NRCS)
- Walter Milton, Jr. (Jefferson Middle School)
- Pedro Manerio (Clinton Avenue Learning Center)

Teachers Participating from RCSD in 2003-2004 Academic Year:

First Name	Last Name	Teaching area	School/Grade
Ellery	Palma	Math	Charlotte 7/8
Paula	Coniglio-Gillies	Math	Charlotte 7/8
Margaret	Brazwell	Bio/Gen Science	East High 9-12
Lynn	Panton	Bio/Earth Sci/Gen Sci	East High 10
Steven	Colabufo	Math	East High 9-10
Paul	Geary	Chem/Bio	East High 9-12
Valerie	Huff	Math	East High 9-12
Brian	DiNitto	Math /Technology	East High 9-12
Allison	Leckinger	Math/Spec ed.	East High 9-12

Tanya	Wilson	Math/Spec ed.	Edison Tech 9-12
Jamie	Foos	Special Ed	Edison Tech 9-12
Lisa	Englert	Bio/Chem	FDMS 7/8
Daniel	Esler	Chem/Gen. Science	FDMS 7/8
Kenneth	Schultz	Ind. Arts/ Technology	FDMS 7/8
Tina	Thomas	Math	FDMS 7/8
Julia	Maloney	Science	FDMS 7/8
James	Phillips	Math	Franklin High 9
John	Goodwin	Math	Franklin High 9
Dion	Rahill	Math	Franklin High 9
Chioma	Owunwanne	Math	Franklin High 9/10
Mark	Chomyn	Earth Sci/Bio/Gen Sci	Franklin High 9-11
Uma	Mehta	Bio/Gen Science	Franklin High 9-12
Mary	Davey	Math/Technology	Franklin High 9-12
John	Zoller	Technology	Franklin High 9-12
Caroline	Rodriguez	Biology	Freddie Thomas 7/8
Michael	Baskin	Bus Tech	Freddie Thomas 7/8
Joann	Bell	Math	Freddie Thomas 7/8
Stephanie	Monk-George	Bio/ Gen. Science	JMSE 8
Bruce	Mellen	Math	JMSE 8
Natasha	Bell	Bio/Chem	Josh Lofton 9-12
Jacqueline	McClaney	Business/Technology	Josh Lofton 9-12
Yolanda	Wooten	Math	Josh Lofton 9-12
Tonette	Graham	Math	John Marshall 7/8
Raymond	Yeaton, Jr.	Chem/Bio/Physics	John Marshall 9-12
Colleen	O'Mara	Math	SOTA 8
Margarette	Douyon	Chem/Bio	SOTA 8-12
Jeffrey	Mikols	Math	SOTA 8-12
Karen	McCann	Biology	SWW 9-12
Kenneth	Steffen	Math/ English	SWW 9-12

Rose	Gulley	Math/Technology	Wilson Magnet 9-10
Sounthone	Vattana	Math/Technology	Wilson Magnet 9-11
Moneith	Burney	Special Ed Math	Wilson Magnet 9-11
Lisa	Dennison	Bio/GenSci/Technology	Wilson Magnet 9-12
Vanessa	Youmans	Math/Technology	Wilson Magnet 9-12
Michael	Meise	Math/Technology	Wilson Magnet 9-12
Darcy	Barrant	Math/Technology	Wilson Magnet 9-12
Peggy	Foos	Math/Technology	Wilson Magnet 9-12

Brighton Central School District (BCSD):
Dr. Henry J. Peris - Superintendent
Jeanne Strining -Assistant Superintendent for Instruction
Tom Hall-Vice Principal of Brighton High School, Project Coordinator at Brighton
Steven Whitman, Senior Physics Teacher at Brighton High School

School Principals Participating from BCSD:
Terence M. Quinn (Twelve Corners Middle School, TCMS)
William Maxwell (Brighton High School, BHS)

Teachers Participating from BCSD in 2003-2004 Academic Year:

First Name	Last Name	teaching area	School/grade
Dr. Lakshmi	Rao	Chemistry	BHS 9/11
Kimberle	Ward	Biology	BHS 9-12
Vincent	Vitale	Math	BHS 9-12
Keri	Rouse	Brighton/Math	TCMS 7/8
Jeffrey	McKinney	Brighton/Science	TCMS 7/8
Ed	Chi	Brighton/Science	TCMS 7/8

Brockport Central School District:
Jane Bowdler (High School Math Teacher)
Karthik Rajasethupathy (7th grade student)

Assignment of Faculty Advisors and Coaches to Schools at RCSD and BCSD:

Faculty Advisor	District Coaches	Schools
Sue Barocas	Gerry Moon, Tanya Wilson Natasha Bell, Yolanda Wooten	Edison HS Lofton HS
Robert Tuzun	Ellery Palma Valerie Huff	Charlotte MS East HS
Leigh Little		

	Dan Esler Sounthone Vattana	Douglas MS Wilson Magnet HS
K. Raj	Christina Olsowsky Michael Meise	James Madison MS Wilson Magnet HS
Jose Maliekal	Vincent Vitale Ed Chi, Keri Rouse	Brighton HS Brighton MS
Dawn Jones	John Goodwin, Dion Rahil, Chioma Owunwanne	Franklin HS
Mark Heitz	Michael Baskin, Joann Bell Ken Steffen	Freddie Thomas LC School WW
M. Tahar	Ray Yeaton Steve Colabufo	Marshall HS East HS
Peter Veronesi	Colleen O'Mara	School of the Arts (SOTA)

Shodor Education Foundation: Dr. Garret Love (Instructor), Dr. Robert Panoff (Director)
Krell Institute: Barbara Helland (Technical Consultant, Associate Director)
Texas Instruments: Melody DeRosa (Technical Consultant),
Vince Doty (Training Specialist), Donna Roberts (Training Specialist)
Independent Evaluation Consultant: Linda Reid

The Council of Chief State Schools Officers:
Rolf Blank, Andra Williams, Carlise Greenfield
The American Institute of Research: Kwang Suk Yoon
Wisconsin Center for Education Research: Andy Porter, John Smithson

Other Collaborators and Consultants: Dr. Rubin Landau (Oregon State University), Dr. Greg Moses (Univ. Wisconsin-Madison), Y. Deng (SUNY Stony Brook)

1. Overview

The overall goal is to improve math and science education at partnering institutions in the Rochester area. Our project builds upon a strong partnership between SUNY College at Brockport and two area school districts (Rochester City School Districts (RCSD) and Brighton Central School District (BCSD)). Each partner has different needs, yet recognizes that it needs others as part of the solution. School districts demand better teachers from higher education institutions in order to answer the demand by area colleges for better students. Our project involves: 1) a college that is the largest producer (26%) of all bachelor's degrees in the area, but is facing dramatic decreases in math and science enrollments, 2) an urban school district (RCSD) with a large student population (35,000), a large minority population (84%), achievement rates as low as 11% and gaps as wide as 50 percentage points in state math exams,

and 3) a suburban school district (BCSD) with higher achievement rates (79%) but facing persistent gaps among groups of different socioeconomic status, ethnic, gender, and grade levels. SUNY Brockport will play a central role in promoting a new approach to math and science education, providing better teachers to the Rochester area, and sharing outcomes and findings of this study with other local, regional, and national school districts and colleges. The two school districts with different achievement data and goals can benefit from the college as well as from each other. Outside reviewers of our project believe that this urban-suburban model could result in new lessons for a national implementation.

Our project also builds upon a partnership between math, science, and technology subject areas, departments, and their faculties in each partnering institution. Enabled by computational technology and use of mathematical modeling to solve real-world problems, we are able to implement an integrated approach to math and science education. We have formed a multi-institutional and multi-departmental Institute to coordinate project activities. The Institute is co-managed by the college, RCSD and BCSD; facilitating involvement of key people in all partnering institutions through open decision-making and a shared vision, which played a key role in solidifying the partnership. Using an integrated technology approach to math and science education, SUNY Brockport draws strength from its well-qualified faculty, its unique computational science department (the only in the country), and its strong teacher preparation programs to fix a local problem with national ramifications. Experienced staff at BCSD, Texas Instruments, Shodor Education Foundation, and Krell Institute is also assisting the college. Partnering school districts might adapt proposed technology and instruction at different grades, thus creating a wide perspective and a diverse pool of teachers and students to adopt the proposed integrated approach. We all learn from each other and advance through example and interaction. Shodor and Krell have been an integral part of national development, training, and dissemination efforts. As members of NSF-funded projects, they organized and implemented training sessions for building a national reservoir of secondary math and science teachers to lead the nation in the use of technology in the classrooms. We are taking advantage of their previous experience while using their national stature to disseminate our findings and newly developed materials. Our partnership involves participation of regional and local industry such as Xerox to facilitate internships and industrial perspective for students, teacher candidates, and teachers in our project.

Specific Objectives:

1. To improve student outcomes in math and science at grades 7-12 at RCSD and BCSD through an integrated technology approach to math and science education.
2. To increase retention of high quality math, science, and technology (MST) teachers through professional development (summer workshops, coaching, and certification).
3. To increase the number of students majoring or seeking teacher certifications in MST programs at SUNY Brockport through scholarships and internships.
4. To strengthen relationship with the local industry such as Xerox Corporation through internships to MST students.
5. To foster collaboration with industry such as Texas Instruments through use of new instructional technology.
6. To foster collaboration with national programs and organizations such as Shodor and Krell, through dissemination, building evidence, and sharing results and training materials.

2. CMST Pedagogy

We use an *integrated approach* to math, science, and technology education. This new approach, namely computational (math, science, and technology) or abbreviated as CMST, uses math modeling and computer simulations to aid teaching, learning and studying math and science. The characteristics of the CMST approach include inquiry-based, project-based, and team-based instruction. CMST approach (pedagogy) takes the learner-centered or constructivist approach recommended by the national and state MST standards. There is evidence that technology applications can support higher-order thinking by engaging students in authentic, complex tasks within collaborative learning contexts. The literature contains evidence that education can be considerably improved by focusing on higher-order cognitive skills using project- and inquiry-based authentic learning, which is generally more effective than traditional didactic presentation in improving students' problem-solving skills. The CMST approach can even transform uninvolved, at-risk students into active and invested learners. CMST tools can be used to teach about a scientific topic via a series of student-controlled experiments and simulations without having the student know the mathematical and scientific details of the phenomenon under study. This simple framework allows one to introduce a topic and then move deeper with more mathematical tools after students gain a higher level of interest and knowledge. This motivational and layered aspect of technology is a principal reason that educators strive to master and apply it. This project works closely with outside consultants, including other NSF MSP projects, to gather more evidence that could contribute to a culture of evidence for MSP program and particularly the CMST approach.

3. Sustainability and Institutional Change

Active participation of faculty, teachers, and administrators in this project will be ensured in many ways, including institutional commitments and individuals' interests to be part of a larger community with experience of sharing of ideas and discovery of new and emerging technology in the sciences and mathematics. The institutional changes sought in this partnership will help sustain project activities beyond the duration of the award. In the first year of the project (2003), many activities and elements of this project were incorporated into new Strategic Plans by partnering institutions. The new institutional plans put partnerships, professional development, instructional *best practices*, and access to technology among high priorities. One of the milestones of this project, accreditation by NCATE (National Council for the Accreditation of Teacher Education) for SUNY Brockport's teacher preparation programs has just been accomplished. Input by teachers and administrators from partnering school districts has played an important role in the design of new changes and improvements in college's teacher programs. This partnership brought credibility and quality to teacher programs at SUNY Brockport, which led to issuance of accreditation. This will attract more students to the profession of teaching among college students at Brockport and it will lead to hiring of more of them by RCSD and BCSD, which will help sustain the partnership even after the award expires.

SUNY College at Brockport has established bachelor's and master's degree programs in computational science. New York State Education regulations require a master's degree for permanent teaching certification. Combination of degree programs in CMST and NCTAE accreditation of teacher programs will lead to higher enrollments for math and science programs at Brockport and it will help many RCSD and BCSD teachers obtain certifications. The College Senate and SUNY Administration are reviewing a five-year combined BS/MS degree program

submitted by the computational science department. RCSD has started a new tuition reimbursement program to encourage its math and science teachers to seek certification. About 60% of RCSD teachers do not have permanent certification. Knowledge of discovery of new and emerging technology in the sciences and mathematics in college's new CMST programs should be an attraction for many years to come for teachers and teacher candidates in their pursuit of a college education. Technology expansion targeted by all partnering institutions will generate a new learning environment that will survive much longer than the duration of the NSF award. For example, in support of this project, BCSD is giving laptop computers to all of its MST teachers. This not only will help enable current teachers but it will also set new standards which will be followed as an example for many years to come.

The partnership has formed a center (CMST Institute) to coordinate project activities. The Institute is co-managed through co-directors from each partner. Establishment of this center was to institutionalize the partnership so it can last beyond the duration of the award. The Institute's summer workshop has been registered as a credit-bearing college course. The center will continue to exist after the NSF funding expires. The school districts will continue to support teachers attending the activities of the center. We expect that there will be other school districts wishing to utilize the center's services. The Monroe County School Boards Association will assist us by facilitating communication among 20 districts in the area. School districts will use their own budgets as well as other local grants to both expand this project and continue its activities. During the period of NSF funding, there is support for teachers and instructors in the form of stipends, while the college charges no tuition and classroom facilities are available without charge. After NSF funding ceases, the summer institute will continue in the form of a college course, which will be counted towards master's level programs. School districts will continue to send teachers. RCSD will provide tuition support for its teachers while BCSD will continue to provide technology assistance to teachers (through laptops, calculators, and hand-held devices) to its MST teachers attending project activities beyond the award duration.

This project promotes a strong collaboration between higher education and school districts about infusing CMST-based pedagogies and tools into courses and curricula. In 2003, participating teachers and faculty have developed more than 100 lesson plans. Teachers have access to these lesson plans. The volume of lesson plans and ways to incorporate them into curriculum will increase in the next five years. A total of 5 courses in the college incorporated CMST tools in their content and syllabi. A new course has been registered to teach CMST tools to both undergraduates and graduate students at the college.

Partnership among MST faculty members at the college has been increased tremendously after the formation of the CMST Institute. The Institute offered training and laptops to more than 10 faculty members in its first year. Members meet among themselves and also with schoolteachers and coaches frequently. CMST faculty members have developed new joint proposals and articles within the past year. These collaborations have already laid a foundation for a long-term partnership among mathematicians and scientists in the college. The continued sense of community and ownership of the project has created a strong bond between schoolteachers and CMST faculty. Please see attached testimonies of faculty and teachers about this. The project leadership facilitated involvement of key people in all partnering institutions through open decision-making and a shared vision, which played a key role in solidifying the partnership.

Currently participating teachers have been told many times that they need to take proactive roles as full partners in this project. Even during the proposal development phase, our leadership was one of few that brought teachers to the MSP workshop in Washington. This culture is expected to last through presence of the CMST Institute, offering of summer workshops, school districts' tuition reimbursement program, and integration of CMST tools and pedagogy in courses and curricula at each institution. Dissemination of project results and team-based presentations by teachers, faculty, and administrators at national settings will enhance the sense of a regional and even national community. The Shodor Education Foundation and the Krell Institute will play an important role in bridging between our project participants and other colleges and school districts in the country. The repository of lesson plans and its dissemination through web and CD-based media will continue to link us with both Shodor and Krell.

3. Tools and Major Activities

- A multi-institutional center to coordinate meetings, project activities, and development of new courses and challenging curricula using technology-based pedagogy.
- A summer institute to provide training to teachers as part of professional development. Teachers will receive academic credits, a stipend, and technology tools to enable them to extend project activities in their classrooms and school districts.
- A yearlong mentoring program to offer professional development to participating teachers through coaches at school districts and faculty at the college.
- Pedagogically improved courses and challenging curricula at the college and in the school districts.
- Development and documentation of CMST training materials and lesson plans.
- A Scholarship opportunity for teachers and teacher candidates to pursue a BS or MS degree in computational science and technology.
- A project-based Challenge program to promote collaborative work among project teachers, their students at grades 7-12, and college faculty mentors.
- Reciprocal visits by faculty and teachers to classrooms at the college and school districts.
- Interaction between college faculty and schoolteachers from different districts.
- Dissemination of results and lesson plans to other teachers in the country.
- Testing of new uses for instructional technology (hand-held devices and calculators).
- Development and administration of evaluation instruments and surveys (web-based and paper-based) to measure student learning and teacher quality.
- Evaluation and analysis of progress and targeted benchmarks by outside consultants.

4. Professional Development

This project is based on the premise that, more than anything else, *improving teacher quality* will help improve student achievement across all groups. Our main implementation will be to train 145 middle and high school teachers as well as a limited number of teacher candidates and faculty members at the college. Under the coordination and organization of the multi-institutional CMST Institute, we offer four major activities as listed below, including a 4-week summer institute, a coaching program throughout the year, a scholarship program, and a project-based Challenge program for both students and teachers. Raising the quality of MST teachers is at the heart of our effort.

A. CMST SUMMER INSTITUTE

In summer 2003, we offered an introductory training workshop for MST teachers (grades 7-12). Starting in summer 2004, we will also offer an advanced workshop for teachers who want to further improve their content and pedagogy skills and those who want to develop a new course (elective or an AP course) in their schools. Ideally, we would like all teachers to go through both introductory and advanced workshops to maximize the impact on their classroom teaching and professional development. However, based on similar experience by the Shodor Foundation, we expect that only half of the teachers we serve the first time will choose to return for advanced training. The two-stage training, as illustrated in Table I, will help us prepare district mentors and coaches to become Lead Teachers in their school districts for years to come. We reached out to about 150 teachers in 2003 during our planning and informational meetings. The feedback from teachers and school administrators has been incorporated into the process of application and determination of benefits and responsibilities. Teacher feedback was also incorporated into the content, length, and time of the summer institute. We received more than 90 applications for a 50-seat summer institute.

The ultimate goal of this project is to improve student achievement; therefore we will weigh the needs of schools and student groups when selecting teachers. School administrators help us select teachers based on individual interest, need and desire for improvement as well as the need of their schools. We target a mix of experienced and new teachers to help both new teachers and to create strong leaders for training other district teachers. We also target a mix of middle and high school teachers, and a mix of math, science, and technology teachers as described below.

An important premise of this project is the integrated approach to math and science topics. We are promoting a partnership in teaching and learning both mathematics and science. The content of summer institutes will be relevant to grades 7-16 math and science curricula. CMST tools and approaches taught in the summer workshops can be applied to a variety of topics and levels, including freshmen at the college. There will be an advanced workshop for teachers and faculty members who want to further explore infusion of CMST tools into their teaching. The Rochester City School District has started a restructuring from schools with grades K-5, 6-8 and 9-12 to only K-6 and 7-12. Therefore, most of RCSD teachers attending our program will work in a combined learning setting as targeted here. Tailoring teacher professional development to needs of individual schools will be realized during the yearlong coaching activity, which is explained later. Each school will have 1-2 coaches and 1-2 designated CMST faculty advisors to help them implement acquired tools and knowledge into their classrooms. CMST faculty members and coaches will make several visits to classrooms for observation and assistance.

Based on feedback received from district administrators and schoolteachers, CMST Faculty members, and training specialists from Shodor Foundation and Texas Instruments, we registered the summer 2003 introductory workshop as a college course with 3 academic credits. The development of this course has necessitated weekly meetings by representatives and chairpersons from math, computer science, computational science, physics, biology, chemistry, earth sciences, and education departments at the college. Topics included:

- Computer and network training (use of laptops and educational software),
- Calculator training (TI-83 Plus) and its use in math and science courses,

- Math and Science modeling software tools (Excel, STELLA, AGENTSHEETS, and INTERACTIVE PHYSICS)
- Computational Science methodology (rate of change, numerical integration, and visualization of results),
- Data collection and analysis tools and experiments,
- Support for integration of technology into teaching (examples of lesson plans),
- Curriculum Support (i.e., Connected Math, Core Plus),
- Support for Curriculum Alignment with State Standards.

The table below reflects our strategy to cover as many new teachers as possible while allocating necessary resources to advanced training that would lead to new courses and challenging curricula and other institutional changes at core partners. This scheme would train 145 new **CMST Teachers**, including 70 **CMST Lead Teachers** who would receive advanced training. The advanced training will also be registered as a graduate-level course at Brockport. About half of the Lead Teachers are expected to become **CMST Coaches** to support CMST Teachers and Lead Teachers at their schools throughout the year. The **CMST Faculty** will mentor the CMST Coaches, Teachers, and Lead Teachers throughout the project. The project will offer technology support (laptops, calculators, software tools) to teachers attending the introductory workshop.

Table I: Two-stage professional development strategy and yearlong coaching activity timetable.

Activities & Support	Number of Teachers Receiving Service and Support per year					
	2003	2004	2005	2006	2007	**Total**
Summer Training	50 Intro	25 Intro 25 Adv	40 Intro 10 Adv	30 Intro 20 Adv	15 Adv	145 Intro 70 Adv
Coaching Support		50	25	40	30	145
Technology Support	Number of technology items per year					
	2003	2004	2005	2006	2007	**Total**
Laptops	50	25	40	30		145
Calculators	50	25	40	30		145

We aim to reach every math, science, and technology teacher within RCSD and BCSD; directly or through CMST Coaches, Teachers, and Lead Teachers. There are 252 math and science teachers at RCSD and 41 at BCSD. CMST Teachers will be required to pair up with at least one teacher in their district who will not be able to attend project activities directly. The district will use its professional development conference days to provide turnkey training for those teachers who did participate in the program to teachers who did not attend the program. Also, new teachers will receive training on the instructional methods during their monthly "new teacher in-services".

B. CMST COACHING

The coaches need to be aware of project expectations and CMST-related tools in order to be able to help other participating teachers in the school districts. The selection of 20 CMST

Coaches took place during the summer institute based on their performance and sustained interest in becoming a coach.

Goals of the CMST Coaching Activity

- Provide a follow-up mechanism for the summer institute training
- Provide support for team projects
- Help CMST Teachers with content, pedagogy, materials and strategies
- Provide a mechanism for interaction between CMST Teachers in their home districts
- Provide interaction between CMST Teachers and the CMST Faculty
- Provide interaction between CMST Teachers and Coaches from partnering districts
- Promote awareness of NCTM, NSTA, and NCATE standards
- Promote curriculum alignment with State standards
- Provide technical support to CMST teachers on hardware/software issues

Qualifications expected from CMST Coaches

- Attendance in CMST Summer Institute
- Ability and willingness to give time, energy, and support to teachers
- Tenure and permanent certification
- Experience with use of technology in the classroom
- Excellent content/grade level knowledge
- Demonstrated capacity for professional reflection
- Confidence to encourage the CMST teachers to take risks and grow
- Demonstrated instructional leadership within his/her discipline

C. CMST EDUCATION

Another activity to support professional development is a CMST-based formal education. The NY State requires completion of a master's degree for permanent certification. Sixty percent of RCSD and eleven percent of BCSD math and science teachers do not have a MS degree. Although this project cannot completely cure the problem, it will plant seeds of a long-term training program. Through a CMST Scholarship program, we will promote teaching profession among undergraduate students at the college, improve teacher quality, and increase the retention rate at partnering school districts. Additionally, RCSD will offer a tuition reimbursement program to support CMST-based education and certification for its teachers.

SUNY College at Brockport will provide a comprehensive CMST-based content training to in-service teachers and graduating seniors at the college. The interdisciplinary program at the college in *computational science* offers a CMST-based education at BS and MS levels to teachers and students from a variety of backgrounds. Students in this program combine basic CMST skills with a specialization in a content area of choice (math, science, or technology). A graduate of this program gains skills and background in multiple areas; thus becoming a very marketable teacher in school districts. Graduates of this program are now employed in both the high tech industry (i.e., Xerox, Kodak, Lockheed Martin) as well as the K-12 public schools in Rochester. Candidates would be recruited from RCSD and BCSD teachers as well as graduating seniors at the college who plan to become teachers.

D. CMST CHALLENGE

The CMST Challenge program will start after the summer workshop and will encompass the school year in which teams of students and teachers complete science projects. The makeup of the teams and their project topics will be determined after the summer training. We will create teams of two teachers and two students per teacher. Bringing MST teachers together on the same team will give a chance to integrate knowledge and expertise. Throughout the program, help and support will be given to the teams by the CMST Coaches and Faculty. CMST teachers will select students based on their GPA, prior coursework, computer experience, and desire to learn about science and computing. Although there will be differences (grade and background) among challenge students, we expect each selected student to be up to the challenge among their peers in their classrooms. CMST Teachers will be advised to ensure equity of all groups and full participation of underrepresented groups, particularly minority and female groups whose performance drop in middle and high schools has received regional and national attention. If the selection follows the statistical make-up of student population in each district along with the allocations given to each district, then this will ensure a just distribution that core partners have agreed upon.

During the Challenge experience, students will be engaged in simulations, problem solving, and inquiry- and project-based learning to stimulate their interest and learning. The activities will involve students in making decisions about their learning, thus empowering them to become more involved in the learning process. Connection in content will be made to urban situations that students can relate to. In addition to being an educational experience, the Challenge will be an avenue for competition, designed to encourage students to perform at the highest possible level. To encourage participation, projects will be placed in divisions according to mathematical background and grade level. For example, teams made up of students who have completed Algebra I will compete against similar teams. Participants at all levels will be able to attain many levels of recognition. Trophies will be awarded for teamwork, technical writing, presentation, creativity, innovation, modeling, code performance, and multimedia.

5. Evaluation Plan

The evaluation design will be both formative (process-oriented) and summative (results-oriented), employing naturalistic inquiry for capturing complex interactions, patterns of student/teacher learning and changes in teacher strategies and in student motivation, interest and achievement in math, science, and technology. The formative evaluation will examine usefulness and appropriateness of software tools, whether or not they need to be replaced as part of midcourse corrections. It will examine coaching activities to find out whether we need more coaches. The length of workshops and orientations as well as the selection criteria for teachers and students will be among parameters for midcourse corrections. We will survey teachers, students, and coaches and we will hold interviews. While it will rely on more traditional scientific inquiry for student outcomes, these measures will occur frequently to determine if the project is on target in meeting its' goals and objectives. To measure the impact of project activities on participating students, both quantitative and qualitative methodologies will be employed. Teachers will submit weekly logs to project management. Designated coaches will make classroom observation and provide input on a regular base. The project principals will work with district coaches to develop an annual Teacher Impact Survey (TIS) for grades 7-8 and 9-12.

First, descriptive statistical comparison of pre-and post-measures of academic achievement in math, science and integrated technologies will be compiled and maintained and reviewed on a frequent basis. A database will be constructed on the target population to enable longitudinal following for a 5-year period. Second, general attitude and motivation orientations as well as specific knowledge and attitudes will be assessed three times per year for program alignment and revisions.

The Advisory Board will meet in spring and summer to review the data and make recommendations to school principals and participants. A Memorandum of Agreement will be signed between the Research Foundation of SUNY, represented by the PI, and school districts, represented by school principals, to ensure that teachers participating in the proposed programs are adequately assisted, supervised, and monitored in their professional development. After summer institutes, a joint one-day workshop will be conducted by superintendents for school administrators (principals and assistant principals) to integrate our project's goals and expectations into the overall accountability measures for schools, mentoring coordinators, mentors, and teachers involved.

Outside consultants will be involved in project evaluation and advise us on statewide results. The records will be housed at the CMST Institute. The project will develop a web site for project members, teachers, students and for the public. An annual report will be prepared for NSF. The partnership will participate in the national analysis of the MSP program and in any further research activities requested by NSF. There will be a strong link to Centers for Learning and Teaching in the state. The achievement gaps will be released to the public by the NY State, and the schools will be held accountable at the county and state levels. The local newspapers and TV channels closely follow school reports, which will be a vehicle to raise public awareness about the new education initiative and NSF's role in it.

Both participating School Districts have in place a system for collecting and analyzing achievement data for all students and this current system will be utilized to disaggregate the data specifically for the targeted teachers and students. Further, this will offer the Districts an opportunity to compare the outcome data from all the intervention programs, including the target population, and to use this data to make the programmatic and policy changes necessary to meet the goals of this program.

Throughout the implementation of the project, participants will provide more personal forms of feedback regarding the activities and educational impact provided. Focus groups and district-designed tests will allow the staff to make the needed mid-course changes and revisions as the data and feedback indicate. The twin tasks of this evaluation are to assess the effectiveness of teacher training as well as the impact on student achievement in MST. For more information on our evaluation plan, please see the 5-year Strategic Plan.

6. Dissemination Plan

We have several regional and national mechanisms for dissemination, including the two supporting institutions (Shodor and Krell) that have been an integral part of national development, training, and dissemination efforts. As members of NSF-funded programs, Shodor

and Krell organized and implemented training sessions for building a national reservoir of MST teachers. In particular, Shodor targets undergraduate faculty at small universities, community colleges and minority-serving institutions. It will provide an instructor and mentor for the summer institute, thereby providing a direct link to other national and regional programs. Sharing instructional personnel will also provide a conduit for disseminating our successes to a nationally distributed audience, integrating and helping to standardize curriculum development at both levels.

We will also work with another partnership program supported by NSF, namely the Partnership for Advanced Computational Infrastructure (PACI). The PI was invited in March 2003 to give a talk at the All Hands Meeting Conference organized by the PACI-Education, Outreach, and Training (www.eot.org). EOT has offered to publicize and disseminate our project activities, lesson plans, and elements of CMST culture of evidence. The link to EOT puts us at the center of the national computational science community in a more visible way, which will contribute to building a more comprehensive culture of evidence. Participation in future NSF's MSP Learning Network events will also help disseminate our results.

Within the last several months, we have presented at several national conferences, including SIAM Computational Science and Engineering (http://www.siam.org/cse), and Supercomputing (http://www.supercomp.org) conferences. We will continue to play a role in these meetings, particularly in the Supercomputing Conference that has an Education Session devoted solely to training of K-12 teachers and undergraduate faculties in computational science. We plan to send at least two teams of CMST Faculty-Teacher-Student combination to present results in these conferences.

At the local level, we will work with the Monroe County School Boards Association to expand our activities to other school districts. They will assist us by facilitating communication among 20 districts in the area. The local media has shown great interest publicizing our project. Our project has been featured in Rochester Democrat and Chronicle, Brighton Post, and several TV and Radio Stations. We expect to promote our annual results through local media and newspapers at Rochester and through the SUNY Newsletter.

At the regional level, we have visibility at the Chancellor's Office at SUNY Central and at the Research Foundation of SUNY in Albany. We helped a sister institution (SUNY Fredonia) initiate a major effort to target scholarships and industrial internships for student in their MST fields. Our focus on CMST has led to establishment of a computational research center at SUNY Buffalo and planted seeds of a Computational Engineering program at SUNY New Paltz. The PI is an Adjunct Professor at SUNY Stony Brook and he plans to apply for SUNY funds to organize a Conversation in the Discipline workshop at which MSP-related findings can be shared with other SUNY schools. Finally, we will set up a web site for this project as early as the first year.

7. WORK PERFORMED

The SCOLLARCITY partnership was put on firmer grounds in 2003. There have been a few major changes since the award announcement. In response to reviewers' comments about reaching out to more math and science teachers, we increased our capacity from a total of 100 teachers to 145. A budget supplement has been requested from NSF.

There were structural changes at partnering institutions. RCSD hired a new Superintendent who then hired new directors of math and science programs. The project leadership facilitated involvement of key people in all partnering institutions through open decision-making and a shared vision, which played a key role in solidifying the partnership. A positive outcome of the leadership change at RCSD was creation of a new Strategic Plan that included innovative technology solutions and regional partnership with higher education that are core elements of this project. The new Plan puts professional development, instructional *best practices*, and access to technology among high priorities as well (A copy of the new RCSD Strategic Plan is available at www.rcsdk12.org). In 2003, a multi-institutional center was founded between SUNY Brockport, Rochester City and Brighton School Districts. The center (CMST Institute) is co-managed by a Director from the College and two Co-Directors from school districts.

The second major test for the partnership was the development and documentation of the 5-year Strategic Plan (S-Plan) and the 1st Year Implementation Plan (I-Plan). The partners held weekly, bi-weekly, and later monthly meetings leading to the submission of the Strategic Plan in July 2003. The location of discussion meetings (involving principals of the project) was alternated between the City, Brighton, and Brockport suburbs. The meetings included both administrative and technical people to sort out details of role and responsibilities of all participants, including teachers, coaches, faculty members, and institutions as well. CMST Co-Director from RCSD (Margaret Crowley) and Project Coordinator from BCSD (Tom Hall) played an excellent leadership role in their districts to talk to teachers and encourage them to attend informational meetings. Our Independent Evaluator (Linda Reid) has been a source of great advice and research data for mid-course corrections. The recruitment of teachers for the summer institute took a great deal of effort by all three partnering institutions, including more than 7 informational meetings, presentations, and communication. The input from teachers attending these sessions was used to adjust the content, length, location, and dates of the summer institute. Collaboration with another MSP partnership project (The Council of Chief State Schools Officers, American Research Institute, and Wisconsin Center for Education Research) helped us collect baseline data in April 2003 from all applicants (target group plus the control group) prior to our summer institute. This collaboration has provided us with evaluation instrumentation that could not have been created using our limited funds set aside for evaluation component.

The third major test was the delivery of pledged support (mostly release time) for principals. It has taken the project leadership and their institutions time and experimentation to accurately assess necessary institutional support. Initial estimates seem to hold and all partners have contributed in some form or another. The college and Rochester City School District provided tuition support and facilities. Brighton provided laptops for all of its MST teachers. The college provided facilities for summer training. Computer labs were upgraded at the college and school districts. Partners also contributed through staff time, though this is hard to measure. The college granted a course release for the CMST director in spring 2003 and it stands by its pledge

to do the same every semester for the duration of the project. CMST Faculty members were advised by the Dean to use their scholarship and personal time to contribute to the project. Thus far, support in the summer (via salary) and during academic year (via scholarship time and extra service) has adequately enabled delivery of essential services and maintained faculty engagement throughout the whole year. Teachers rated CMST faculty members 'excellent' for their knowledge and dedication to the project.

CMST Faculty spent a tremendous amount of time in spring 2003 on updating the content of the summer institute. Since this project involves use of technology tools, we need to be aware of latest tools in the field at all times. With Shodor's input, the project adapted new tools such as STELLA, AGENTSHEETS, and Interactive Physics to replace FORTRAN and MATLAB originally considered for summer training. In Spring 2003, with the help of Garrett Love from Shodor, a training session was organized for all CMST faculty members about these tools. A similar effort took place with the Texas Instruments. The content discussions involved CMST Faculty members, instructors from Shodor and Texas Instruments as well as project coordinators, school principals and teachers from the districts. We managed to register the summer institute as a credit-bearing course for teachers and students in teacher preparation programs at Brockport. The advanced version of the summer institute will be developed by Spring 2004 for the upcoming summer. We expect the same process, however, this time we will also involve the Krell Institute members who are specialized in topics more suitable for advanced training.

The 2003 Summer Institute was very successful. It took a great deal of teamwork to do it. Hiring of a Project Coordinator (Sue Barocas) early enough in the process (April 2003) brought fresh energy as well as perspective of a former math teacher into a college setting. She brings not only her knowledge of math but also her administrative experience (as director of math instruction) and connections to teachers. Hiring of a secretary (Amanda Duncan) the week before the Summer Institute made a great deal of difference. She is an Office Wizard and does things very quickly. We made mid-course corrections as we encountered problems, including registration of participants; space and air-conditioning issues; purchase of laptops, calculators, and software tools; cloning laptops and installation of software on college computer network; negotiations with vendors; organization of course materials, content of the course; management of office hours, weekly meetings by the Instructional Team; ceremonial gatherings, picnics, interviews with TV shows, Newspapers, and many other tasks. As reported by our Independent Evaluator in the next section on Quantitative Data, hundred percent of participants rated the summer institute as a success.

Maintaining of our success (achieved with the summer institute) in the months ahead will be our top priority as teachers and college faculty integrate the CMST tools and approach into their teaching. Implementation of the lesson plans developed during the summer and early fall will be crucial for improvements in student achievement to be reported at the end of this school year (9/03-6/04). Work on development of Student Impact Test (SIT) and Teacher Impact Survey (TIS) will begin by early 2004. Technology access at schools is an important issue and will be improved. We will hold monthly talks with teachers, coaches, and school principals about their needs. At the minimum, each CMST teacher should have a laptop and access to an LCD projector to be able to teach math and science topics using integrated approach through visual

representations and simulations. Details of activities such as coaching, turnkey training, and the CMST Challenge program will be worked out by the end of October. NCATE accreditation application by the college has received favorable recommendation. A combined BS/MS program in Computational Science has been designed and submitted to the College Faculty Senate for approval. School districts have started discussions on changes to curriculum maps and this process will take a considerable time to come to fruition. For additional information on upcoming activities and their projected timeline, please refer to the Implementation Plan for the 2nd year attached to this Annual Report.

ACTIVITIES AND FINDINGS

(**Reported by the Independent Evaluator- Linda Reid)**
The proposed activities the Project staff accomplished from January 2003 to September 2003 to achieve the first year goals (in the 1st Year Implementation Plan) are summarized below.

- Signed a Memorandum Of Agreement (MOA) by SUNY College at Brockport, Rochester City School District and Brighton Central School District.
- Established the Computational Math. Science, and Technology (CMST) Institute to coordinate project activities and develop and teach courses using a new pedagogy (integrating fieldwork, laboratory experiment, math modeling, computer simulation, and visualization). The CMST Institute is co-managed by three directors by core partners.
- Promoted elements of CMST approach at newly developed RCSD Strategic Plan
- Promoted elements of CMST approach at the College's new 5-year Strategic Plan under development.
- Signed subcontracts with Shodor Education Foundation. The subcontract with Krell Institute has been sent to the Research Foundation of SUNY for legal matters before it is submitted to Krell for signature.
- Signed a partnership agreement with Texas Instruments, which led to a saving of $14,000 for our project.
- Signed a partnership agreement with The Council of Chief State School Officers, which led to a saving of $17,775 as direct support (stipend and catering) for 70 teachers as well as travel support of $11,000 to project members to attend workshops on Building Evaluation Capacity. This relationship is expected to save our project hundreds of thousands of dollars that otherwise would have gone into development of evaluation instrumentation by our own staff.
- Established a partnership with IBM on educational technology support for K-12 teachers. The relationship led to a saving of $78,500 by our project.
- Established a partnership with MSC Software and High Performance Systems on educational technology software support. This relationship led to a saving of $5,900.
- Improved teacher preparation programs through application for NCATE accreditation. The process will continue with further feedback to the college about its programs.
- Improved teacher preparation programs through creation of a new in-service/pre-service course. This course infused CMST methodology and tools into a course that can be taken by all math, science, and technology teachers and teacher candidates. The Board of Study for Teaching Mathematics and Science approved the course content. The Dean signed off on it.

- Improved math and science education at the college by integrating CMST tools into 4 college courses, including CPS 101 Introduction to Computational Science, NAS 401/501 Computational Approaches to Math, Science, and Technology Education, ESC 350, Computational Methods in the Field Sciences**,** MTH 313 Mathematics for Elementary Teachers. More courses are expected to use CMST tools and approach in the 2003-2004 school year.
- Helped promote quality at SUNY Brockport. The College was upgraded from a Tier 3 ranking to a Tier 2 category as a result of increasing the percent (60%) of incoming freshman enrollment who have a high school average of 90 and/or SAT scores of at least 1200. This fall's jump from Tier 3 to Tier 2 marks the culmination of a multiyear effort by Brockport officials to attract a higher caliber student body. The option of offering a Computational Science program was a key factor in attracting students who scored high on SAT. Participation in the MSP Learning Network to exchange results and expertise with other granted projects has been consistent since the inception of the project.
- Reached to more than 150 MST teachers through informational meetings and presentations by college faculty visiting the school districts. About 90 applications were received and reviewed. School principals were involved in the reviewing and recommendation of all applying candidates. Offers were made to 56 teachers and 6 college students. Contracts were signed with teachers to manage the handling of resources and expectations of the summer institute as well as commitments to a mentoring activity after the training. Integration of CMST tools and pedagogy into teaching was made a requirement through two lesson plans.
- Implemented a 4-week summer institute providing training to 55 teachers as part of professional development. The institute included 6 college students, two of which were offered a teaching job by RCSD as a result of such training. All participants received academic 3 credits.
- Tuition support provided by the college for 6 SUNY Brockport students, 48 RCSD teachers and one administrator, and 6 BCSD teachers to take a summer course at Brockport. The project funds also offered tuition support to 7 students and 4 teachers in fall 2003.
- Tuition reimbursement provided by Rochester City School District to MST teachers taking courses or seeking MS degrees to obtain permanent certification at SUNY College at Brockport. Data will be collected in early 2004.
- IBM laptops were provided by Brighton Central School District to all of its MST teachers
- IBM laptop computers were provided by the project to 55 teachers and 10 instructional faculties. Also provided college-licensed education software tools and CMST-licensed new tools such as STELLA, AGENTSHEETS, and Interactive Physics.
- Texas Instruments TI-83+ graphing calculators were provided by the project to 55 teachers, 10 faculty members, and 6 teacher candidates and a middle school student (7^{th} grader Karthik Rajasethupathy) who attended the whole summer institute. The middle school student did a demo at the graduation ceremony displaying his pool table model using the Interactive Physics. Teachers were stunned by student's success and pledged to promote similar successes in their own districts.
- Training was provided to 20 coaches who have been assigned to work with teachers from the summer institute during the school year. A schedule for bi-monthly meetings was developed. Dates are: 8/12, 10/08, 12/10 in 2003 and 2/10, 3/1, 4/6, and 5/10 in 2004.

- A List Server (ANGEL) has been set up to disseminate summer workshop materials, including 55 lesson plans developed by college faculty and participating teachers at the end of the workshop.
- A database (EXAMgen) of questions aligned with NY State MST student learning outcomes was made available at RCSD by district administration in support of our Strategic Plan goals.
- Began the initial stages of a Challenge program to serve students at grades 7-12. An Interactive Physics Day was organized on October 14, 2003. SUNY Brockport hosted more than 50 secondary school students and 5 physics teachers on its campus.
- Established a mentoring program at Brighton Central and Rochester City school districts to offer professional development to participating teachers. Hired 20 coaches at two districts.
- Established a schedule for mega meetings to bring together Brockport faculty, RCSD and BCSD teachers and coaches who attended the 2003 summer institute.
- Established an action plan and met with stakeholders to implement strategic plan of core partners for pedagogically improved courses at SUNY Brockport, RCSD, and BCSD.
- Steps to modify curriculum maps at partnering school districts have been initiated.
- A combined BS/MS program in Computational Science has been submitted to the College faculty Senate in fall 2003.
- Collected, adapted, and refined course materials from previous NSF and DOE programs with the help of Shodor Foundation for classroom teachers. Help by Krell will be sought in early 2004 for advanced training materials.
- Promoted the CMST pedagogy and curriculum via a journal paper to appear in SIAM Review (Vol. 45, No. 4) in November 2003. Credit to NSF MSP program will appear on the front page. SIAM is the primer society of Applied Mathematicians and Computational Scientists (ww.siam.org).
- Promoted CMST approach at several national conferences, including SIAM Conference on Computational Science and Engineering in February 2003 at San Diego. Also, attended MSP Learning Network Meeting in January 2003 at Washington, D.C.
- Invited to talk at All-Hand-Meeting by the NSF NPACI-EOT (www.npaci.edu/ahm2003/) in February 2003 at San Diego. The mission of the NSF-funded National Partnership (of more than 50 institutions) for Advanced Computational Infrastructure (NPACI) is to advance science by creating a ubiquitous, continuous, and pervasive national computational infrastructure.
- Invited to participate in NSF PACI Partnership meeting at NSF (Arlington, VA) on October 20-21, 2003 to discuss promoting CMST approach to a national audience. This might provide new resources to our project's dissemination effort.
- Promoted CMST Integrated Approach to math and Science Education at SUNY system. The PI was selected as a member of the University Senate Graduate Education and Research Policies Committee. He was subsequently appointed as the Senate Liaison to the Research Foundation of SUNY. He was invited to serve on a SUNY-wide Mathematics Education Task Force. Through his membership and appointment in these SUNY-wide committees, the PI has promoted NSF's MSP program and the CMST approach. He was also invited by the President of SUNY College at New Paltz to help initiate a Computational Engineering program.

- News Releases and TV interviews were granted to local media during the opening ceremony of the CMST Institute. Occasional news releases are also being published in the Democrat and Chronicle, Brockport Post, and Brighton-Pittsford Post.

BENCHMARKS AND QUANTITATIVE DATA

The following sections are direct responses to questions and benchmarks in the Evaluation Section of the 1st Year Implementation Plan.

A. Partnership:

1. *Did all partners agree upon a shared vision for SCOLARCITY Partnership?*
2. *Did core partners define mutual goals, responsibility and accountability?*

The project documentation verifies that all partners did agree upon a shared vision at the inception of the project and this collaborative effort has continued throughout both the planning and implementation periods of this project (copy of Memorandum of Agreement is available).

This major effort did encounter significant shifts due to a notable change in staffing at the Rochester City School District. During the planning stages of the project the PI collaborated with the Superintendent and the Directors of Math, Science and Technology departments, as well as the Director of Academic Instruction. Midway in the process, after all agreements had been approved, the Superintendent left the position and was replaced by a new Superintendent. Further, the Directors of Math, Science and Technology retired from their positions due to an early incentive offered by New York State Education Department. Newly appointed staff filled these positions. Several of the building Principals who were originally recruited to participate in the Project also retired or were transferred. Additionally, the Chief Academic Officer was replaced during the same period.

Finally, in 2002-03 the District began implementing a plan for restructuring the system from a middle school (6-9) high school (9-12) configuration to a comprehensive 7-12 structure. All of these considerable changes have presented unique challenges to the implementation of the project. Despite these significant changes, the PI was successful in rebuilding new relationships with the new staff by fostering good communications, open decision-making and teamwork with the new players and stakeholders. According to information collected through staff interviews, new members believed that the project leadership, by involving and supporting people of different skills and backgrounds, was able to build on the enthusiasm of individuals and ensured broad participation. Further, the outcomes of the project are perceived as relevant to the stakeholders and matter to both teacher participants and district leadership.

3. *Did the partnerships strengthen relationships with local industries? What evidence supports this?*

Promoting each partner's common goal, by taking advantage of the strategic alliances, and offering appropriate prices for technology tools strengthened partnerships with IBM and Texas Instruments. Teacher feedback to IBM and Texas Instruments regarding classroom application of their tools has been beneficial. The training of teachers by Texas Instruments staff received extremely positive responses from teachers and the teachers were satisfied with the access to T.I. staff in support in the use of graphing calculators from Texas Instruments.

In a reflective statement from Shodor Education Foundation's instructor, Dr. Garrett Love writes:

> I believe the Summer Institute was effective in exposing the participants to the basic concepts of computational science and modeling, and introduced a good variety of tools, thereby increasing the chances that participating teachers would be able to find a tool they were comfortable with and thus incorporate the technology into some aspect of the classroom.
>
> Currently the SCOLLARCITY project is quite regional in scope, although that is somewhat expected in the initial phases. The lead institution (SUNY Brockport) is obviously serving as a valuable resource for the Rochester area schools, but in order to extend the scope and impact of the project, it will be necessary to identify shareable outputs or potential outputs of the project (curricula, best practices, teacher leaders) and to establish how these and other resources (faculty and staff expertise, computational infrastructure, facilities) can be used to augment similar projects led by other institutions.
>
> In particular, it is of great interest to Shodor as to whether the model piloted this past summer – namely the introduction of computational science content and methods to a concentrated core group of faculty associated with an MSP – is an effective structure and approach for reaching both undergraduate and secondary classrooms, and whether Shodor can demonstrably serve as a resource for MSPs in general. Demonstrated effectiveness of our collaboration will lead to 'institutional change' in Shodor in the form of increased involvement with MSPs, perhaps as a stated objective.
>
> In addition, Shodor has extensive involvement with the Education, Outreach and Training arm of the National Partnership for Advanced Computational Infrastructure (NPACI). A key EOT-PACI project led by Shodor is the Computational Science Education Reference Desk (www.shodor.org/cserd), which serves as a repository for computational science materials and curricula generated by Shodor and various collaborators and partners. It is my expectation that curriculum generated by CMST faculty and perhaps even participant teachers will be submitted for publication, thus expanding the impact of the generated curriculum as well as the scope of the repository. I have high expectations that as this project matures it will generate resources in support of institutional change on a national scope.

4. *To what extent did the project foster collaboration with industry to enhance new instructional technology?*

Assessment of the technology tools by teachers was conducted during the CMST Summer Institute. The initial results have been shared with Texas Instruments and will be used by the company in revising and updating their tools and training material. Additional feedback will be collected from teachers throughout the project period to provide information to technology partners.

5. In Year 1, to what degree did the partners promote the CMST Institute?

To date, significant promotion occurred among partners through press releases, adequate release time for project staff and a high level of cooperation between partners. District partners encouraged teachers to enroll in the CMST Summer Institute and all partners worked together to overcome any barriers that arose in the implementation process. For example, the original plan of the Summer Institute's daily schedule was totally revised to accommodate teachers who had committed to teaching summer school in the mornings in Rochester. While the change presented some adaptation for faculty members, the process occurred swiftly and the needs of teachers, faculty and trainers were met. CMST staff, together with input from partners, has designed a new informational and recruitment brochure that will be disseminated in a variety of venues during the 2003-04 school year.

6. Was Project successful in establishing collaboration with the MSP longitudinal study and OCCSSO by April of Year One?

The CMST Project is actively involved in a partnership study with another MSP (RETA) project. Staff is working with Rolf Blank from Council of Chief State School Officers as a participant in their study of professional development in mathematics and science instruction. Surveys have been administered and PDA Activity Logs have been set up. A total of five CMST staff has attended the MSP Conferences and Evaluation Workshops during this project year. Approximately six CMST staff will also be attending a two-day MSP workshop in Baltimore on October 16 and 17 2003.

B. Teacher Preparation:

1. In project year 1, 100% of the 50 available spaces in the CMST Summer Institute will be filled by teachers by May 15 2003

The CMST Summer Institute recruitment effort was 100% successful; enrollment goals were met and exceeded. Eighty-eight (88) teachers applied for participation in the CMST Project, a total of 56 teachers were accepted. Both urban and suburban enrollment objectives were met.

2. Ten (10) faculty from SUNY Brockport, 2 veteran instructors from BCSD/RCSD will participate in the training of 50 teachers per year

The 10 Brockport faculty participated fully in the four-week training of 56 teachers include:

- Computational Science (Yasar, Tuzun, Little)
- Mathematics (Jones)
- Computer Science (Raj)
- Physics (Tahar, Mancuso)
- Chemistry (Heitz)
- Earth Sciences (Maliekal)
- Education (Veronesi)

A veteran science and technology teacher from Brighton School District (Steve Whitman) also participated in the training.

The instructor from Rochester City School was unable to schedule training due to conflicting job responsibilities and was replaced with a newly retired Math teacher from the RCSD (S. Barocas) who previously taught Mathematics at the Monroe Community College.

Teachers were surveyed with a 49-question survey at the end of the Summer Institute and 25 exit interviews were conducted between July 28 and July 31, 2003. The results were used to answer questions # 3 through #9 below. (See Survey Results in Appendices)

3. Did participants feel their time was well spent?

100% of the participants rated their experience as beneficial (42%) to very beneficial (57%). 70% of the Math teachers rated the Institute as very beneficial. 100% of the participants stated that they would recommend the program to other teachers.

4. Did the materials make sense? Will they be useful?

76% of the teachers found the materials to be extremely useful and the other 24% stated that the materials were somewhat helpful.

Teachers recommended that for next year's Summer Institute, CD's be created with specific modeling applications for classroom use. Middle school teachers recommended that more materials for middle school teachers be added. Science teachers suggested seeing more science. Because of the integrated approach to math and science (through use of technology), all of the teachers are asked to learn beyond their own specialty. The CMST Institute needs to insist on asking math teachers to learn more science and asking science teachers to learn more mathematics and technology. The research shows that no textbooks/workbooks exist for the K-12 educator in the area of computational science or in any of the companion disciplines. CMST faculty and presenters spent significant time and effort researching and assembling materials, which they believed, would be helpful for the 7-12 grade teachers. One of the tertiary benefits of this project is that through their collaborative work in the CMST project, faculty and teachers have already begun creating lesson plans and assessment tools for classroom use. Throughout the five years of the project the development of these curricular tools and materials will provide a usable body of working materials for teachers in the area of computational science for the classroom.

5. Was faculty knowledgeable and helpful?

The Instructional Team (Brockport Faculty, District Teachers, TI Training Specialists, and Shodor Training Specialist) was rated by teachers in a survey by our Internal Evaluator (Veronesi) as being very successful (>4.5 on a scale of 5). In his own words, Dr. Peter Veronesi (a Science Educator at the Education Department) states:

> "From my observation and professional judgment, I feel that the goals of the CMST summer Institute were accomplished and that the event came off as a smashing success! Teachers where engaged and challenged during the entire time.
>
> It is quite evident that ALL CMST instructors are *very* committed to the success of the entire program. CMST faculties want to see the teachers/participants succeed with their students as they begin to infuse the learned technologies in their classrooms. This particular group of instructors is extremely committed-they feel ownership in the Institute. And, it seems likely from the comments of

> the final survey that a great majority of the teacher participants were looking forward to implementing the various technologies and strategies."

Additional surveys by External Evaluator (Reid) also showed that overall teachers expressed high satisfaction with the faculty. Teacher Survey results showed that participating teachers from the Summer Institute ranked 80% of the CMST faculty as excellent to very good in Knowledge in the subject matter. 71% believed that they had "very good" access to faculty throughout the four-week sessions and 29% said access was "good". One participant, a science teacher, said access was fair.

In exit interviews participants expressed high satisfaction with faculty and believed that all faculty members were extremely helpful in supporting participants' learning efforts and activities. Teacher ranking of faculty was highest by the less experienced teachers. (100% of the teachers with less than 15 years experience not only ranked faculty as extremely knowledgeable and helpful but also were very enthusiastic about their satisfaction in exit interviews. Examples of teacher comments from the survey include:

- "The Institute was very good"
- "Instructors could not have been humanly better!"
- "I originally thought about quitting the program because the pace was so fast, but the professors were so accommodating and truly put everyone at ease. The entire staff was excellent; they made everyone feel competent. Faculty readily stayed later to help trouble shoot problems."
- "I feel that we accomplished a ton, in the short amount of time we had. This is a credit to the instructors and organizers."
- "I thank all the instructors for their dedication and interest."
- "There was not one member of the faculty and staff that was not helpful, patient and willing to go the extra mile."
- "This course exceeded my expectations. We are very grateful to the staff of CMST for the opportunity and the wealth of information that was generated. They were very eager to show us what they know. We are just so indebted to you all. Please continue to do this every summer to get more teachers on board. This is a very rare opportunity and as pioneers, we will do our best to promote this in our schools."

Individual rankings of faculty were shared with PI and Project Co-Directors as well as faculty. Individual faculty members are using the evaluations to improve their teaching for the next session.

6. Did teachers acquire the intended knowledge and skills?

While the input from the teachers indicated they believed they definitely acquired the knowledge needed to implement the CMST approach in their classrooms, they were less confident about their level of skills in applications in their classrooms. 36% definitely felt prepared to apply modeling in their classroom this September, whereas 41% were "probably" prepared", 16% were unsure and 7% did not feel prepared. Interview data further revealed that teachers explained that their lack of confidence was due to their need for additional manipulation and experience with these new tools in the classroom. The PI and the CMST Technology Coordinators (Maliekal and Little) have been made aware of this. At a minimum,

teachers must be able to have a laptop (provided by the project) and an LCD projector to display results and experiments on the screen. Ideally, students should have access to computers and CMST tools to learn from their own experience with simulations. School districts are improving the student/computer ratio.

At the outset of the Summer Institute, faculty surveyed teachers to determine their level of competency in technology in order to assess at what level instruction should be focused. Interestingly, faculty reported that teacher's perception of their proficiency was much higher than what faculty actually observed teacher's skills to be.

Teachers recommended that the Summer Institute be expanded by one week in order to give them additional time in "hands-on" use of the tools and applications for the classrooms. Program participants will be providing staff with monthly information via the PDA Activity Logs and weekly via Teacher Activity Logs on ANGEL regarding their actual use of the knowledge and skills they learned in the CMST Summer Institute.

Coaches and faculty mentors will be available to teachers throughout the school year to support classroom implementation of CMST approaches. Through classroom observation and teacher input, coaches and mentors will be assessing the extent and scope of the model applications and teacher use of technology tools for individual instructional support for teachers as well as for programmatic changes in the design of the CMST program. Program planners, as well, are reviewing the recommendations by teachers regarding the strengths and weaknesses of the Summer Institute in order to make modifications and improvement for next years' summer program.

7. What percent of the participants completed the Summer Institute?

The Summer Institute was highly successful in it's objective in retaining 60 of 61 participants. Of those 60: 6 were SUNY Brockport students; 6 were teachers from Brighton Central District; 48 were teachers and one administrator from RCSD; and one teacher and one middle school student from Brockport School District. One RCSD teacher dropped out after the first week due to a family emergency and not related to his satisfaction with or performance in the CMST Institute.

All 60 participants successfully completed their assignments and maintained the rigorous attendance requirements. Approximately one third of the teachers also taught summer school at their District in the morning and drove 45 minutes from the city to Brockport to attend the CMST training sessions. District reports from previous education related workshops held during the past four summers show an average of at least a 10% non-completion rate. Teacher commitment to completion of the Summer Institute was exceptionally high. Teachers who were teaching summer school in their district reported that they already started using in the summer school what they learned the week before in the Summer Institute. This shows a quick turn around time and an unusual excitement among participants.

8. Did teachers receive adequate coaching/mentoring support?

The assignment of Coaches to teachers has been completed on schedule. Orientation meetings with Coaches occurred on August 12, 2003. Coaches have been trained in classroom

observation techniques and On-line Logs have been created to monitor input from both the teachers and the coaches. A mega meeting will be held on October 8, 2003, which will include CMST faculty, Coaches, and Teachers. The coaching activity will be assessed on an ongoing basis throughout the school year and results will be recorded in December 2003 and June of 2004. They will be reported in 2004.

9. How many Brockport teacher candidates with CMST-training were hired by partnering school districts?

Three teacher candidates (Gerry Moon, Chris Olsowsky, Maria Roman) with CMST training were hired by the Rochester City School District; a graduate student in the Teacher Education Program, a master's student and undergraduate student (and a substitute teacher) in computational science department was hired as a permanent Math teacher by the same district.

10. Were the needs of urban participants different than suburban teachers?

There was no statistical difference between the group responses, except in two areas.

- Suburban teachers did not find the technology tools to be an incentive for their participation. They found the quality of training and the uniqueness of the CMST tools interesting. The Brighton Central School District had already committed to providing all the 7-12 grade MST teachers with laptop computers this school year in support of our project. Further, the purchase of graphing calculators by both parents and the Brighton District is also expected to occur this year. The Rochester City School teachers, on the other hand, were very motivated by the offering of these laptops. Most believed that without these technology tools many of the teachers would not have been able to participate in the Summer Institute. Urban teachers stated they did not think the majority of their students would have the financial support to purchase graphing calculators nor did they anticipate that their school would be able to purchase the number needed.
- Five of the six suburban teachers did not anticipate any barriers in their school that would prevent them from fully implementing the CMST approach in their classrooms, whereas all of the urban teachers anticipated some or many barriers in their schools.

C. Curriculum and Classroom Impact:

Current records show that three of the 6 SUNY students were hired by the RCSD; of the six teachers from Brighton, four returned to teaching in Brighton, one (Jeff McKinney) was promoted to an administrative position at Greece Arcadia middle school, and one (Kimberle Ward) accepted an administrative job, as a vice principal at Corning high school (NY). The two teachers who took administrative positions at suburbs of Rochester have submitted proposals to continue promoting CMST approach and help recruit students for Brockport's MST programs.

Of the 48 Rochester City School District teachers, forty-five returned to the classroom; one teacher moved out of the area, two were granted sabbaticals and one was promoted to Lead Mathematics Teacher position (while still teaching). CMST Project staff is working with the two participants who have relocated to new school districts in an effort to explore the possibilities of rolling out the CMST methodology at these new locations. The two teachers on sabbatical are doing research on the CMST pedagogy, are serving as Coaches at their schools and intend to offer CMST training for teachers within the district in 2003-04. The teacher who

was promoted to Lead Mathematics teacher (Jeff Mikols) is working directly under the supervision of the RCSD's Director of Mathematics/CMST Co-Director. In his new position he will be providing CMST training and support for the district math teachers as CMST project Coordinator at his district.

Of the 6 SUNY Brockport students, three were offered positions at RCSD, therefore making up for teachers who took sabbaticals and leaves.

The teacher from Brockport High School (Jade Bowdler) returned to teaching. She is an excellent teacher and is expected to disseminate the CMST approach into her school district. Along with two Brighton teachers who took positions at Greece and Corning, these three teachers are expected to continue their CMST promotional activity beyond the original two districts. As planned, this project is expected to promote CMST approach at other school districts within the Monroe County School Districts Association (MCSDA). The executive director of MCSDA, Jody Siegel, is an Advisory Board member of our project from the beginning.

Teachers have just begun teaching classes. They have agreed to use the PDA Logs and this objective will be assessed as the data becomes available. Preliminary response to using the reporting logs created by CMST on ANGEL during the month of September is averaging about 50% of the CMST teachers. It is anticipated that this will increase in October. Of those teachers who have recorded activities and observations in the online Logs, the information is providing a wealth of teacher input and is expected to be a valuable tool for project assessment and teacher information.

Following are testimonies of 3 teachers from RCSD and BCSD, who have started implementing CMST tools and approach in their classrooms and districts.

Jeffrey Mikols (RCSD –High School Math Teacher):

> "I have had the opportunity to be a participant in the CMST Program at the State University of New York College at Brockport. As a participant in the MSP Project, I received four weeks of intensive training in technology, with the intent of applying this to classroom lesson planning. We were trained on the Texas Instruments TI-83+ graphing calculator, STELLA, AgentSheets, and Interactive Physics. I had the opportunity to apply this training to writing lesson plans that incorporate the use of technology. As the Secondary Mathematics Lead Teacher of the Rochester City School District, I have begun to train teachers to implement technology and promote change in the mathematics classroom.
>
> The SUNY-Brockport MSP Project has helped teachers and administrators by providing training in technology based approaches to mathematics and science lessons. Technology has made it possible to change the way teachers approach mathematics and science to make lessons that are exciting to students and relevant to their interests. New York State Educational Standards specifically target the use of technology as methods of communication and information gathering systems. In the Rochester City School District, I have made it a priority to begin training building specialists on the TI-83+ graphing

calculator so they can train the teachers in their individual buildings. We have trained these specialists in lessons from eighth grade curriculum up to eleventh grade curriculum. The earlier our students are proficient with graphing calculators, the more they will benefit from them as move through high school curriculum. Teachers that participated in the CMST Summer Program are using the training they received and are beginning to implement this training into their classroom and producing high quality lessons. This is a primary step in improving math and science education in our schools.

The professional development provided by the MSP Project has been different than other professional development I have received on many levels. The MSP Project provides teachers with direct training on specific methods to change mathematics and science teaching. Teachers were trained on the technology and then asked to reflect and implement what they learned in planning classroom lessons. The Summer Institute was well staffed with knowledgeable professors. Questions pertaining to the programs we were trained on were answered efficiently yet thoroughly. The training went very fast at times, but there was support available. The MSP Project provides ongoing training during the school year with the expectation that teachers trained are going to continue using the training they received throughout the school year. There are regular checkpoints of accountability in place to ensure that teachers are doing this. The participating teachers have each been assigned a coach to provide help where necessary. This ongoing training and accountability are essential for any professional development to have a lasting effect on the way teachers conduct their practice.

I believe that the greatest barrier in implementing the latest and best research into the classroom is teachers not changing their practice. This failure to change practice is partially because of lack of training or awareness of alternative methods, but also because teachers do not admit the need to change is necessary. The MSP Project is good model to approach this problem. It has provided teachers with the necessary training and subsequent support to facilitate change in classroom practice. As teachers implement technology into their lessons, and students learn more and enjoy mathematics and science more, it is my belief that other teachers who are reluctant to change their practice will take notice of the improved student outcomes and want to change as well. I have begun trying to implement this change in approach with building specialists in my district. The specialists have been very eager to be trained on the TI-83+ graphing calculator, so the potential for change at their individual buildings is a reality. I have seen teachers in classrooms beginning to implement graphing calculators into their lessons, and they are realizing the benefits of using them.

The best way to recruit high quality mathematics and science teachers is create students that love to learn these subjects. If high school students enjoy learning these subjects and see the relevance in their lives that these subjects have, there is a better chance that these students will consider teaching these subjects as a career. There must be exciting opportunities for students to experience technology and real life application in mathematics and science. The MSP Project has tremendous potential to foster this type of interest. Many students have a natural interest in technology and how it is applied. Recently, the MSP Project hosted an Interactive Physics Day where students from

Rochester City Schools and Brighton Central schools received the opportunity to see how technology relates to Physics. I believe the MSP Project could make more inroads into the individual schools by presenting demonstrations for students to participate in. The benefits of teaching mathematics and science must be "advertised" more effectively and earlier in the students' high school career. Teaching must be made a first choice, not a career to fall back on."

Michael Baskin (RCSD- Middle School Math Teacher)

At Dr. Freddie Thomas High School the MSP is closely aligned to the districts initiative to change the teaching culture from teacher centered to student centered. Within the framework of this model is a structured classroom that creates independent learners with guidance and coaching from the teacher/facilitator. Each class is structured around an America's Choice classroom with Rituals and Routines, an Opening, Mini-lesson, Independent learning/exploration, and closing. While we are getting closer to providing high quality education to all students, our biggest obstacle is overcoming student disciplinary issues.

The MSP is not just based in theory. It is practical "real-world" examples of how the math/science/technology concepts look and feel in a real application. It combines the elements of differentiated instruction and multiple intelligences and seeks to engage the student. While it is very intense, I feel the coaches' network and the continued MSP faculty support encourages success in the classroom. Kids want to know how to make the theory real for them and give it meaning. The MSP is aligned to this orientation.

The greatest barriers to bringing the latest research in math and science to the classroom at the RCSD is the lack of available technology. With numerous cutbacks we lack the people to write grants to obtain the technology we need from graphing calculators to computers.

Teacher practice is changing and will continue to slowly change if we can create a learning environment in the classroom. So far the lack of meaningful consequences for behavioral issues is significantly impeding teacher's ability to create a learning environment in their classrooms.

The enthusiasm shared by the first cohort will entice others to partake in the program. This is the best form of promotion/advertising for new participants in the program. Additionally a brief demonstration of the tools and resources and capabilities the program offers should seal the deal. In the immediate future unless your moving forward with your education by continuing the learn you will become one of the uneducated.

The MSP Project is engaging. It asks us to tear down the boxes that may have restricted our thinking in the past and step outside our comfort zones much as we expect from our own students."

Ed Chi (BCSD- Middle School Science Teacher)

"The CMST program has made plans to speak to and collaborate with participating teachers and their administrators. Their goal is to share the CMST mission statement with these administrators

and seek ways to support the efforts of the CMST teachers and coaches. At Twelve Corners we have taken steps to load modeling software onto school networks and share activities and knowledge with faculty at department meetings. The students in my classes have expressed great interest in receiving training on modeling software and creating opportunities to allow them to take charge of their learning.

About the summer workshop: The content was technologically intensive yet practical. We could see ways to integrate them into our own programs. There was a constant theme of interdisciplinary approaches to these activities. They made every attempt to include math, science and technology into every aspect of the training. This was no small feat.
Most professional development workshops end when the presenters and facilitators hand out evaluation forms. The CMST has kept their promise to continue the collaboration well beyond the end of the summer program. We communicate via weekly teacher's logs and coach's logs. There have been invaluable meetings where we have offered feedback and suggestions on ways to make the program more effective. I feel as though I am partly responsible for shaping the CMST program not just participating in it. Perhaps it is because this is a young program in Brockport or because the people are confident enough in their own area of expertise to listen to others. Whatever the reason I feel a true sense of collegiality here.

About barriers: For myself thus far the greatest barrier has been the lack of technology available in the schools. This can stifle the efforts of the teacher to incorporate meaningful activities in the classroom. If it was not for the talents of the CMST faculty I would be unable to provide my students with the ability to explore the connections between science, math and technology in my classroom in a meaningful way.

About incentives: Good pay incentives; access to technology plus the support to get it into the hands of students and use it effectively in the classrooms attracts good teachers and keeps them. I will admit that the pay, technology, and support incentives provided by the CMST program drew me in, and has meet and exceed my expectations."

E. Sustainability and Institutional Change

1. *What steps are being taken in Year 1 to integrate the CMST pedagogy into math and science education at SUNY Brockport?*

Analysis of CMST faculty reports indicates that individual faculty has begun incorporating CMST pedagogy into their classes in a variety of ways. The following excerpts from summaries by faculty show the range and depth of faculty approaches for incorporation in 2003-04. Of the faculty that participated in the CMST Summer Institute, two have been promoted with SUNY Brockport College and their teaching responsibilities have changed significantly. Jose Maliekal has been promoted to the Associate Dean position. He was CMST Coordinator for Institutional Change and we believe his new position will be supportive of his CMST role. The other member (Raj) has been promoted to the Director of Master's in Liberal Studies program, which draws many teachers from the community to higher education at Brockport. Dr. Raj was the

CMST Coordinator for Recruitment and his new position will also be supportive of his CMST role.

Computational Science Department Faculty member:
"All courses in the Computational Science department make extensive use of computational technology to perform modeling and simulation. Besides general purpose tools such as Fortran and C/C++ compilers and Matlab, the courses I teach include use special purpose software packages such as:

- Fire!, distributed by Shodor, used in CPS304 (Simulation and Modeling).
- SIMPROCESS, distributed by CACI, used in CPS304 and CPS633 (Dynamical Modeling).

I plan on adding AgentSheets to CPS304 and CPS633; and Stella to CPS304 and perhaps CPS632 (Deterministic Dynamical Systems)."

Mathematics Department Faculty member:
"I have been using Excel for many years in my courses, where appropriate. I have also been using some of the JAVA applets on the Project Interactive site, especially in my Math for Elementary Teachers classes. I think these applets are very well done and are a wonderful addition to my class. There were a few applets that were introduced to me (such as fire) that I had not used before and I plan to use that in my Math for Elementary Teachers II when we talk about probability.

Three of the tools, Stella, Agent Sheets and Interactive Physics, were new to me, and I found them to be quite interesting. Although I personally enjoyed learning about Stella, I do not see using in my classroom that much. I do think that I can construct models in Agent sheets that would be useful in my class. I am teaching MTH 605 Problem Solving and I plan to use both Stella and Agent Sheets in the class.

If I were teaching calculus, I would definitely use Interactive physics as well, but the courses I am currently teaching do not directly lend themselves to this software.

I have used graphing calculators for many years in all of my classes and will continue to do so. Although I considered myself an expert in the use of the calculators, I did learn a few new tricks that I found to be very useful. I mostly use the graphing calculators in classes such as Calculus, Business Calculus, Finite Math, and Pre-calculus. I look forward to using some of the new applications in my other classes. For example, there is an application called Cabri Junior, which is a tool for doing geometric constructions and calculations. I really look forward to exploring the possibility of using this in my MTH 314, math for Elementary Teachers II and MTH 432/532 College Geometry.

I also plan to offer some training for the Faculty in my Department. I think the faculty would benefit tremendously from tools we introduced to this campus. It is my hope that this training will allow the Departments of mathematics and Computational Science to work more closely on curricular development and perhaps even some cross-teaching of courses in the two departments."

Chemistry Department Faculty Member:

"The primary tool used in courses at this point is Microsoft Excel. In the future, Agentsheets will be incorporated into courses to model probabilistic events that occur in separation sciences."

Physics Department Faculty Member:
"I have used LabView and Excel in my laboratory classes, particularly, College Physics Labs, for the past three years, in fact I initiated implemented its use. In these labs the experiments are set-up on bench tops and data is collected from transducers through a data acquisition board well suited for LabView. The data analysis is carried out using Excel, for graphing least squares fitting, etc. This will continue with the addition of different experiments and their rotation.

Excel has been used for one dimension kinematics and projectile motions. The equations of motion have been specific solutions and are easily entered with formula available with Excel. These equations are used to generate data, which can be used to generate graphs of position, velocity and acceleration as functions of time. These graphs are a powerful way of correlating derivatives to slopes and thus instantaneous velocities and accelerations.

I plan to use interactive physics in my college physics as a tool for visualization and during problem solving sessions. The actual word problems can be set up using interactive physics and stepped through, in parallel with my own narration. Once set up properly a problem can be stepped through providing a visualization and even numerical solution to a word problem. This can provide a check for solving the problem analytically and thus build the student's confidence."

Computational Science Department Faculty member:
"For the courses I currently have, the main tools being used are FORTRAN and C/C++. Two of these courses (CPS 303 and CPS 602) are high performance computing courses that rely heavily on parallel computing. As most high performance computing environments are UNIX/LINUX based, introduction of CMST tools requires creativity. I have found that for CPS 303, there are many opportunities to use the tools (particularly Agent Sheets) as motivation and description of parallel programming assignments. Using Agent Sheets will provide a concrete, visual description of the programming goal. In CPS 602, there are many tools arising that will prove useful. Currently, we make use of the Partial Differential Equation Toolbox for MATLAB. This tool makes the numerical solution of highly complex systems of partial differential equations very easy and accessibly to anyone. MATLAB is purely a serial programming environment, but there are open source tools that work in a similar manner for parallel environments. These include The Portable, Extensible Toolkit for Scientific Computation (PETSc) , PHAML (Parallel Hierarchal Algebraic Multilevel solver), PARMS (Parallel Algebraic Recursive Multigrid Solver).

My other course (CPS 201) concentrates on learning FORTRAN 90. This subject matter is critical to the future success of a student in our program and it is important to have this course remain so in order to assure that students be successful. However, as in CPS 303, the tools can be used as motivation for why certain types of programming tools are needed and can be used to provide concrete descriptions of programming assignments. "

Earth Science Department Faculty member:
"Prior to the Summer Institute, I attended a weeklong training session, which enabled me to learn about three software packages, Agent Sheet, Interactive Physics, and Stella. The CMST training is enabling me to use Stella to demonstrate principles of Earth System modeling in ESC 350, Computational Methods in the Field Sciences. This is a required course for students seeking teacher certification in Earth Sciences. In fact, I have added Earth System modeling as a new topic in ESC 350.

Based on my observations of teachers participating in the Summer Institute, I have observed that schoolteachers are very eager to learn the CMST pedagogy. Their enthusiasm to incorporate modeling and simulation activities into their teaching is very high. An impediment against incorporating new technology is time and resource constraints. One solution might be to make the format of the Summer Institute to resemble that of a Workshop. My experience also tells me that one-on-one (or in small groups) interaction is enabling schoolteachers to learn new technology skills.

In some school buildings, teachers do not have access to adequate technology. Teachers also face time constraints. In addition, a person teaching a class that is directly related to a state-mandated examination, the school district and parents expect them to focus almost exclusively on test. This stifles innovation. Proving already developed lesson-plans might increase teachers' ability to integrate technology into their classrooms."

During the first year of the project, further efforts to include the CMST model are reflected in the college's Strategic Planning committee report submitted to the President by Vice Provost Michael Fox and his Committee, including the Center for Excellence in Learning & Teaching (CELT) Advisory Committee. Two CMST faculties are members of this Committee, which has been examining the question "How can faculty enable students to be better learners?" The CMST model is one of the critical vehicles for addressing this plan, which is summarized below.

2. *Is there evidence that CMST pedagogy is being reviewed for efficacy by national organizations? What is the result?*
An article titled "Elements of Computational Science and Engineering" has been submitted by the PI and accepted for publication in Journal SIAM Review (Vol. 45, No:4). The article has gone through a rigorous review for the past year. It makes direct references to the CMST pedagogy. It is expected to serve as a foundation for national CMST models.

The PI was invited to talk about CMST approach and NSF's MSP program at national conferences. A network of 300 people from SIAM and an audience of 100 people from NSF's NPACI (www.npaci.edu) partnership listened. As a result, he has been invited to take part in the next round of NSF's NPACI Partnership to promote CMST at a national level. He will be at NSF on October 21 to discuss a partnership with the NPACI-EOT institutions.

Regionally, the PI has been promoting CMST at SUNY level. He has been given important opportunities to talk about CMST. SUNY College at New Paltz has invited him to give a talk on October 15 to their campus faculty, which could lead to establishment of a Computational

Engineering program at New Paltz. These efforts all provide opportunity for review of the CMST approach.

3. ***To what degree, district-wide technology tools were available to students and teachers for CMST applications?***

Project Co-Directors, together with Tim Cliby, Director of Instructional Technology at the Rochester City School District, are currently assessing what technology tools are available to the CMST teachers for the 2003-04 school year. On a district-wide basis, this objective will be measured at a later date during the project year. PI and Project Directors have met with the Technology Directors of both Districts to review their long term Technology Plans. The initial survey results, interviews and input from staff and teachers indicate that within the urban district this may be the most complex aspect of the project's implementation plan. Availability and access to technology and software at some urban school sites is good. For example, Wilson Magnet High School (1,000 students) has a Computer Science Program that offers state-of-the-art technology in many of the school's classrooms. Also, at East High School (2,000 students) the classrooms are equipped with full sets of graphing calculators which teachers and students have access to all day, every day. However, at the other participating schools, the technology access is less clear. Within the City School District, computer distribution between Labs, classroom computers and mobile laptops is in varying stages of phase-in and network wiring to accommodate for maintenance of bandwidth is also in flux. Reports show that the district is committed to moving from an aging analog WAN connection by modem to LAN-WAN connections providing digital access but this process is slow due the size of the district, the aging structure of some schools and the overall financial constraints of the district.

The Brighton School District has one high school and one middle school and adequate financial support to provide teachers and classrooms with consistent access to technology tools. Brighton has provided all 7-12 grade teachers with laptop computers and because family income levels (and educational levels) are significantly higher than the urban district, student's parents are more able to provide graphing calculators for them. At the RCSD, where the poverty rate is roughly 80%, families are less likely to provide their children with graphing calculators and the district does not have the funds to equip all classrooms with a full set of graphing calculators.

CMST Project Directors see this situation as both a challenge and an opportunity. All partnerships are exploring different options for approaching the problem and this information will be collected and reported as the project implements strategies to overcome this obstacle.